

IX. *A Determination of the exact Moments of Time when the Planet Venus was at external and internal Contact with the Sun's Limb, in the Transits of June 6th, 1761, and June 3d, 1769,*

By SAMUEL DUNN.

Read Feb. 22, 1770. **I**N the year 1761, I presented to the Royal Society an observation which I made of the external and internal contacts of the planet Venus with the sun's limb, containing several unexpected phænomena in those contacts, which were sufficient to render them uncertain several seconds of time. In that paper I took no notice of that lucid annulus which also appeared to me to extend outwards from the circumference of Venus to the breadth of about 5 seconds of a degree, but was particular in describing a certain narrow waterish penumbra near the limb of Venus, which seemed not to exceed a tenth or twelfth part of the breadth of the lucid annulus, because it appeared to me of a hazy and indistinct colour, and extended itself towards the limb of the sun as the planet approached it, growing more and more dark and broad, so that before Venus's real limb seemed to be at contact with the sun's limb internally, the thread of light was

VOL. LX. K broken,

broken, though faintly. Another circumstance was, that the limb of Venus, near the point of contact, left its circular form. But the instant of time when the thread of light was broken being the object in view, I omitted a detail of those particulars.

In the late transit, June 3d, 1769, I carefully observed several circumstances attending that phenomenon, which seem to me absolutely necessary to be attended to, in order to the exact determination of the time when the internal contact happened; a particular account of them is as follows; viz.

Receiving an invitation from the present Astronomer Royal to be at the Royal Observatory at Greenwich, at the time of the late transit, I determined to be there, rather than any where else, thinking that the experience which I had had of the former transit would enable me to make such an observation as might be acceptable to posterity.

The time came, and the weather proved favourable for making that observation, with all the exactness that could be wished for or desired. Several hours before the transit, having a very distinct idea of the circumstances which appeared in forming the internal contact of Venus with the sun's limb, June 6, 1761, and being almost certain something of the same kind would now happen, I drew out small circular diagrams, representing Venus at several near distances within the sun's disc, with the like obscurity near the point of contact as I had observed in the transit of 1761, and requested Mr. Hirst, Mr. Dollond, and Mr. Nairne, who were likewise to observe, to use their utmost endeavours for determining whether any such impediment occurred

or not; and if it did, to note the circumstances of it.

The clocks to be observed by, were set by the Astronomer Royal, but we were not acquainted with the time they were too fast or slow; and the telescope which I observed with was an excellent achromatic telescope, magnifying 140 times, inverting the object, and made by Mr. Dollond.

The telescope being properly adjusted, and having a most clear and distinct sight of the sun's limb where the external contact was expected to happen; at  $11^h 56' 32''$  per clock (which, reduced by the Astronomer Royal to apparent time, is  $7^h 10' 33''$ ), whilst I was moving my eye gently along that part of the sun's limb where the contact was expected, there appeared as though a kind of lucid wave of transparent matter, of the colour of that part of the lucid annulus (which afterwards appeared round Venus), which was nearest to the limb of Venus, and taking up the space of about a fifth part of a minute of a degree along the sun's edge, this lucid wave seemed to strike gently against the sun's limb, and in an instant the little tremulous vibrations on the sun's limb were totally stopt, and that part of the limb was rendered thereby a little obscure. A second and half of time after this, at the same place of the sun's limb, arose, first gently, and then more violently, a ferment, or boiling, very different in colour as well as magnitude, from the tremulous vibrations at other parts of the sun's limb, for it was darker and much more violent, and at  $11^h 56' 36''$  per clock, or  $7^h 10' 37''$  apparent time, this fermentation was enlarged along the limb of the sun, and

the limb of Venus was entering on the sun's limb as in Fig. 20. TAB. III.

My attention being at this time engaged in examining the place around the point of contact, I endeavoured to see a kind of brown penumbra precede the limb of Venus, but saw none; instead thereof a kind of whitish light, at first very faint, and afterwards as it advanced on the sun's disc becoming more strong, preceded the limb of the planet; which light gradually diminished nearer to Venus, and formed a narrow margin of lucid matter, whereby the limb of the planet became a little ill defined. Almost the same circumstances happened in the exterior contact 1761, but with this difference, the lucid border then following, the limb of Venus was more clear and transparent. I was the more particular in these circumstances, to be able to determine what differences might arise from observations made with telescopes and eyes equally good, and conclude from the phenomena, that two such observers, with but little inequality in their judgments, might differ from each other ten seconds of time. Before this contact and a little after it, I endeavoured to find a faint illumination on the exterior limb of Venus; but could find none, till the time of internal contact drew near. Another circumstance attending the phenomenon was this; the limb of Venus which first entered on the sun's disc appeared to be the arch of a very small circle; but as the planet advanced onward on the solar disc, that same preceding part of Venus appeared to enlarge and expand itself, and the subsequent part of Venus which was on the sun's limb, appeared as though it was the portion of a smaller circle



circle; and thus the planet appeared to the time of central ingress, at which time half the planet appeared a semi-ellipsis, the conjugate diameter forming the notch in the sun's limb. After the time of central ingress, whilst the latter half of the planet was passing over the sun's limb, the like appearances occurred, so that, although that circumference was really concave to Venus's centre, a little after the central ingress, it appeared a little convex to that centre, and so the planet advanced, that part of it which was nearest the sun's limb appearing contracted, but enlarging itself a little farther on the disc.

The planet being considerably past the central ingress, and being at broad black contact with the sun's limb, but of an irregular form on account of the abovementioned circumstances, and it being hard to judge what kind of contact would appear, I perceived a very faint luminous crescent exterior to the limb of the sun; and nearly coinciding with the preceding limb of Venus continued over the sun's limb. See Fig. 23. This crescent was very faint, but steadily defined at certain fits and returns till 7<sup>h</sup> 28' 30'' apparent time. When this crescent being come near to the limb of the sun, it vanished, and seemed to fall in with a kind of confused slight illumination in the limb of the sun itself, where the internal contact was to happen. At the same time a kind of partial and very faint illumination took place, both a little without, and a little within the sun's limb, as well as in the limb itself, where the contact was to be, and a gentle ebullition or boiling arose a little without the sun's limb on the limb of Venus, which  
continued

continued till the dark body of the planet was wholly within the sun's disc, or  $7^h 29' 28''$  apparent time, when Venus's circumference was not passed coinciding with the sun's circumference above three or four seconds of time. Whilst I was attentively viewing this, and judging it difficult to determine the exact moment of circular contact, on account of the circumstances described, the ebullition or boiling between the limb of Venus and the sun became more violent, and the partial illumination increased; and at  $7^h 29' 38''$  I saw the planet as it were held to the sun's limb by a ligament formed of many black cones, whose bases stood on the limb of Venus and their vertexes pointing to the limb of the sun. These cones put on various positions, and as Venus advanced they alternately contracted themselves towards the limb of Venus, and expanded themselves towards the sun's limb, performing their undulations always regularly and in the same time, as the planet advanced on the disc, till  $7^h 29' 48''$  apparent time. At the end of this interval, the agitation or fermentation was exceeding violent, for the whole limb of Venus would sometimes librate towards the limb of the sun, and sometimes the limb of the sun would turn convex in yielding towards Venus; but the thread of light was not yet formed, for still three or four broad parts of the ligament never had yet broke from the sun, and therefore the thread of light was not yet formed. I carefully examined the sides of those black cones connected with the limb of the sun, and saw the fissures or spaces between them to be filled with a steady illumination, of the colour of twilight compared with the light  
of

of the sun ; and whilst I was steadily attending to these circumstances, I saw the pure and genuine light of the sun break in between some of those fissures like streaks of lightening, which made the partial light become in two or three seconds of time, of the same colour as the light of the sun, yet still the undulating ligament though reduced was not broken. And now,

In an instant, the northern part of the divided ligament withdraws itself from the sun's limb about half way towards Venus, and instantly but gently it returns and again unites the limbs of the sun and Venus ; instantly after, another less northern part of the ligament does the like, and then breaks off again, and so doth each part of the divided ligament, till 7<sup>h</sup> 29' 51'' apparent time, when the ends or vertexes of the black cones between Venus and the sun's limb appear to be separated from the sun's limb, retreating to that of Venus, and dissolving or dying away like a drop of tinge thrown into water, and now the thread of light becomes compleat.

The internal contact being past, and Venus being wholly on the sun, I examined the space surrounding Venus, and saw such a lucid annulus around the planet as appeared in 1761. The part of this annulus next to the limb of Venus appeared a little dusky, but much more clear than in 1761 (when it appeared more confused, and as a penumbra) ; but that part of the annulus farthest off from the circumference of Venus appeared to me a little tinged with blue. The breadth of the annulus about five or six seconds.

Upon hearing a gentleman in the lower apartment call out to be shewed the atmosphere of Venus, I now left my telescope, went down stairs to Mr. Nairne and Mr. Dollond, and desired them to be attentive at their telescopes, and they would see this shining annulus, which they attended to, and after a little while saw it plainly, although for some time they could not perceive any such thing. Then the other gentlemen present saw it, but not before me nor them.

These observations being made, I state the first external contact at  $7^h 10' 37''$  apparent time for Greenwich. Circular contact internally at  $7^h 29' 25''$ . Completion of the thread of light at  $7^h 29' 48''$  under the circumstances above described.

Although I would not willingly form any hypothesis from the aforementioned phenomena, there is one of them, namely, the appearance of the well-defined streaks of light between the fissures, which seems accountable for thus. The partial light which preceded it, I take to be rays scattered by refraction and reflection through that part of the planet's atmosphere where the contact was to happen; and the well-defined streaks of light following it, I take to have been the sun beams passing between mountains on the surface of Venus's globe.

To this account I have added several drawings of the appearances in the transit of 1761, and of the like appearances in the transit of 1769; and must here beg leave to explain the meaning of an expression made use of by me in the account of the former transit of 1761, in Phil. Trans. In that account,

count, by the expression, *no loss of light*, I mean, that at those times the thread of light was not broken, but only obscured by the brown or dark penumbra which interposed between Venus and the limb of the sun.

In the drawings, TAB. III. Fig. 1. 2. 3. 4. 5. 6. shew the penumbra which interposed in 1761, with the correspondent times. Fig. 11. 12. 13. 14. 15. 16. are the similar appearances in 1769. Opposite to which are the times of those appearances by different telescopes, which table of different telescopes was formed from experiments. Fig. 7. 8. and 9. 17. 18. and 19. shew how much the planet's figure differed from a circle in both transits. Fig. 10. shews the external contact for 1761, and Fig. 20. the external contact for 1769, and Fig. 21. 22. 23. 24. 25. 26. 27. 28. are more exact representations of the phænomena at the times there mentioned.

Samuel Dunn.

Venus on the Sun June 3<sup>d</sup> 1769.

Venus on the Sun June 6<sup>th</sup> 1761.

Sky

1769

The SUN

Fig. 21.

The lucid Annulus

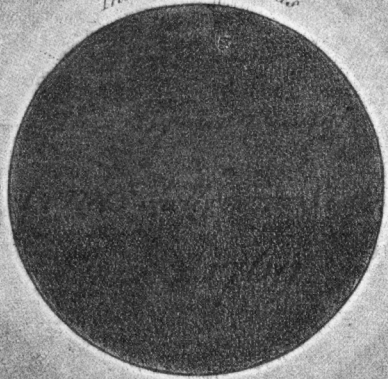
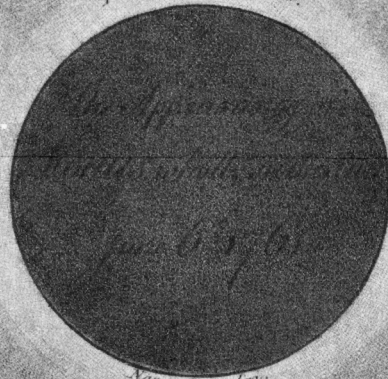


Fig. 22.

The lucid Annulus



Narrow Penumbra

Observations of the Sun  
In the Years 1761 & 1769  
Referred to the Royal

Phenomena in the Year 1761.  
For Black Per Clock Sun's Limb

The Times per Clock for 1761 are the Original Numbers & other Times per Clock for 1769 are the Original Numbers & observation was made in the Royal Observatory at Greenwich.

| Black Atoms flowing to of the | from Venus the Limb of the Sun | Black Atoms touching the | from Venus the Limb of the Sun | Black Atoms break the | from Venus the Thread | Thread of | Light broke | Black   | Ligament |
|-------------------------------|--------------------------------|--------------------------|--------------------------------|-----------------------|-----------------------|-----------|-------------|---------|----------|
| Fig. 1.                       | Fig. 1.                        | Fig. 2.                  | Fig. 2.                        | Fig. 3.               | Fig. 3.               | Fig. 4.   | Fig. 4.     | Fig. 5. | Fig. 5.  |
| 8.16.40                       | 8.18.11                        | 8.16.49                  | 8.18.14                        | 8.16.51               | 8.18.10               | 8.16.53   | 8.18.50     | 8.17.0  | 8.18.56  |

Observations of the Transit of VENUS over the Limb of the Sun  
 Years 1761 & 1769. with the Circumstances & correspondent Apparent  
 as seen from the Royal Observatory of GREENWICH, PARIS, &c.

By Samuel Dunn.

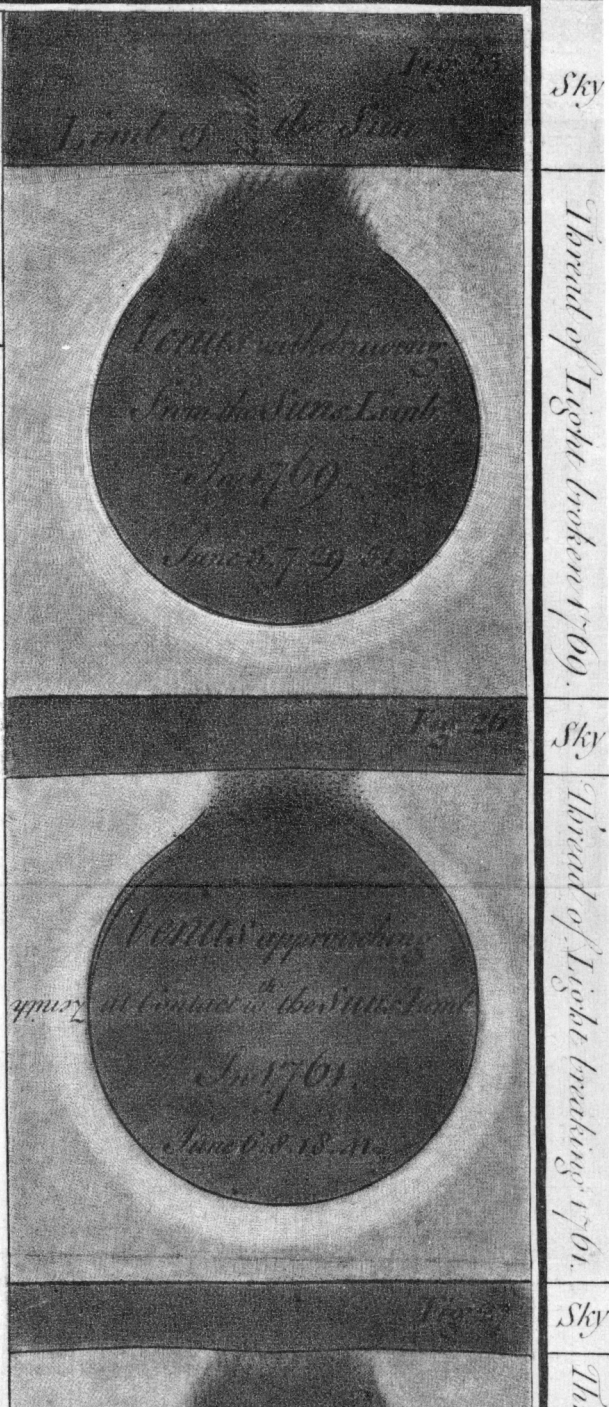
| Phenomena in the Year 1761.        |  | Phenomena in the Year 1769.        |  | The Time of External & Internal Contact at both Paris & Greenwich by Telescopes of different Powers, referred to Greenwich. |                                |                                |                                |
|------------------------------------|--|------------------------------------|--|---|--------------------------------|--------------------------------|--------------------------------|
| For Greenwich.                     | For Paris.                                     | For Greenwich.                     | For Paris.                                   |   |                                |                                |                                |
| Year 1761.                         | Year 1761.                                     | Year 1769.                         | Year 1769.                                   |   |                                |                                |                                |
| Sun's Limb                         | Sun's Limb                                     | Sun's Limb                         | Sun's Limb                                   |   |                                |                                |                                |
| Atoms to from Venus the Limb       | Black Fibres retreating of Venus from the Limb | Atoms to from Venus the Limb       | Black Fibres breaking of Venus from the Limb | Internal Contact June 6. 1761.  | External Contact June 6. 1761. | External Contact June 3. 1769. | Internal Contact June 3. 1769. |
| Certain to 2 <sup>d</sup> of Time. | Certain to 2 <sup>d</sup> of Time.             | Certain to 2 <sup>d</sup> of Time. | Certain to 2 <sup>d</sup> of Time.           |   |                                |                                |                                |
| Fig. 1.                            | Fig. 11.                                       | Fig. 12.                           | Fig. 13.                                     |   |                                |                                |                                |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.41   | 8.37.3                         | 7.10.37                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.39   | 8.37.1                         | 7.10.39                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.37   | 8.36.59                        | 7.10.41                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.35   | 8.36.57                        | 7.10.43                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.33   | 8.36.55                        | 7.10.45                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.44   | 8.37.3                         | 7.10.37                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.42   | 8.37.1                         | 7.10.39                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.40   | 8.36.59                        | 7.10.41                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.38   | 8.36.57                        | 7.10.43                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.36   | 8.36.55                        | 7.10.45                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.46   | 8.37.3                         | 7.10.37                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.44   | 8.37.1                         | 7.10.39                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.42   | 8.36.59                        | 7.10.41                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.40   | 8.36.57                        | 7.10.43                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.38   | 8.36.55                        | 7.10.45                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.46   | 8.37.3                         | 7.10.37                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.44   | 8.37.1                         | 7.10.39                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.42   | 8.36.59                        | 7.10.41                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.40   | 8.36.57                        | 7.10.43                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.38   | 8.36.55                        | 7.10.45                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.50   | 8.37.3                         | 7.10.37                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.44   | 8.37.1                         | 7.10.39                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.46   | 8.36.59                        | 7.10.41                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.44   | 8.36.57                        | 7.10.43                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.42   | 8.36.55                        | 7.10.45                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.55   | 8.37.3                         | 7.10.37                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.53   | 8.37.1                         | 7.10.39                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.51   | 8.36.59                        | 7.10.41                        | 7.29.                          |
| 8.18.11                            | 8.18.33  | 8.18.43                            | 8.18.44                                      | 8.18.40   | 8.36.57                        | 7.10.43                        | 7.29.                          |



*The Limb of the SUN*  
*Correspondent Apparent Times*  
*at PARIS, &c.*  
*by Samuel Dunn.*

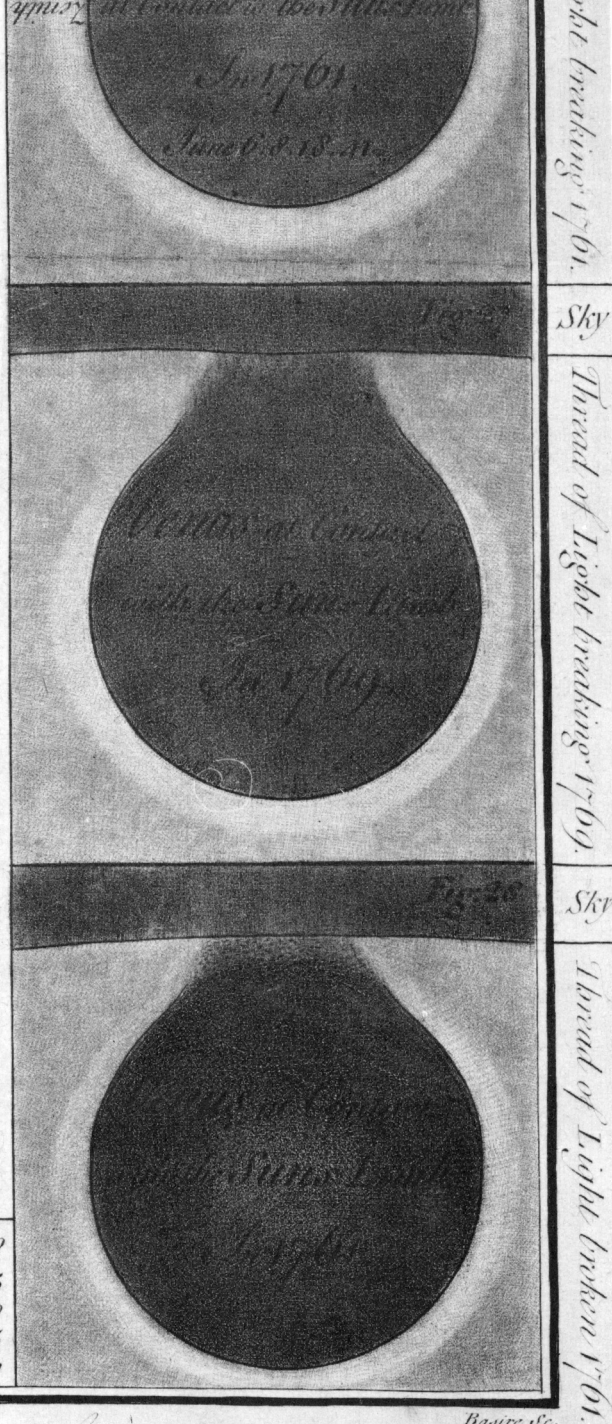
*Internal Contact at both Transits*  
*at Flowers, referred to Greenwich.*

|    | External Contact, June 3 <sup>d</sup> 1769 | Internal Contact, June 3 <sup>d</sup> 1769 | by different Telescopes. | Mag. Time |
|----|--|--|--------------------------|-----------|
| 3  | 7.10.37                                    | 7.29.46                                    | 7.29.37                  | 150       |
| 1  | 7.10.39                                    | 7.29.44                                    | 7.29.35                  | 125       |
| 50 | 7.10.41                                    | 7.29.41                                    | 7.29.33                  | 100       |
| 57 | 7.10.43                                    | 7.29.39                                    | 7.29.31                  | 75        |
| 55 | 7.10.45                                    | 7.29.37                                    | 7.29.29                  | 50        |
| 3  | 7.10.37                                    | 7.29.43                                    | 7.29.32                  | 150       |
| 1  | 7.10.39                                    | 7.29.41                                    | 7.29.30                  | 125       |
| 50 | 7.10.41                                    | 7.29.39                                    | 7.29.28                  | 100       |
| 57 | 7.10.43                                    | 7.29.37                                    | 7.29.26                  | 75        |
| 55 | 7.10.45                                    | 7.29.35                                    |                          | 50        |
| 3  | 7.10.37                                    | 7.29.41                                    |                          | 150       |
| 1  | 7.10.39                                    | 7.29.39                                    |                          | 125       |
| 50 | 7.10.41                                    | 7.29.37                                    |                          | 100       |
| 57 | 7.10.43                                    | 7.29.35                                    |                          | 75        |
| 55 | 7.10.45                                    | 7.29.33                                    |                          | 50        |





|    |          |         |     |
|----|----------|---------|-----|
| 3  | 7.10.45  | 7.29.33 | 150 |
| 1  | 7.10.37  | 7.29.37 | 150 |
| 59 | 7.10.39  | 7.29.35 | 125 |
| 57 | 7.10.41  | 7.29.33 | 100 |
| 55 | 7.10.43  | 7.29.31 | 75  |
|    | 7.10.45  | 7.29.29 | 50  |
| 3  | 7.10.37  | 7.29.32 | 150 |
| 1  | 7.10.39  | 7.29.30 | 125 |
| 59 | 7.10.41  | 7.29.28 | 100 |
| 57 | 7.10.43  | 7.29.26 | 75  |
| 55 | 7.10.45  | 7.29.24 | 50  |
| 3  | 7.10.37  | 7.29.20 | 150 |
| 1  | 7.10.39  | 7.29.24 | 125 |
| 59 | 7.10.41  | 7.29.22 | 100 |
| 57 | 7.10.43  | 7.29.20 | 75  |
| 55 | 7.10.45  | 7.29.18 | 50  |
| 3  | 7.10.37  | 7.28.42 | 150 |
| 1  | 7.10.39  | 7.28.40 | 125 |
| 59 | 7.10.41  | 7.28.38 | 100 |
| 57 | 7.10.43  | 7.28.36 | 75  |
| 55 | 7.10.45  | 7.28.34 | 50  |
| 3  | 7.10.37  | 7.27.57 | 150 |
| 1  | 7.10.39  | 7.27.55 | 125 |
| 59 | 7.10.41  | 7.27.53 | 100 |
| 57 | 7.10.43  | 7.27.51 | 75  |
| 55 | 7.10.45  | 7.27.49 | 50  |
| 3  | 7.10.37  | 7.25.58 | 150 |
| 1  | 7.10.39  | 7.25.56 | 125 |
| 59 | 7.10.41  | 7.25.54 | 100 |
| 57 | 7.10.43  | 7.25.52 | 75  |
| 55 | 7.10.45  | 7.25.50 | 50  |
| 3  | Fig. 20. | 7.10.37 | 150 |
| 1  |          | 7.10.39 | 125 |
| 59 |          | 7.10.41 | 100 |
| 57 |          | 7.10.43 | 75  |
| 55 |          | 7.10.45 | 50  |

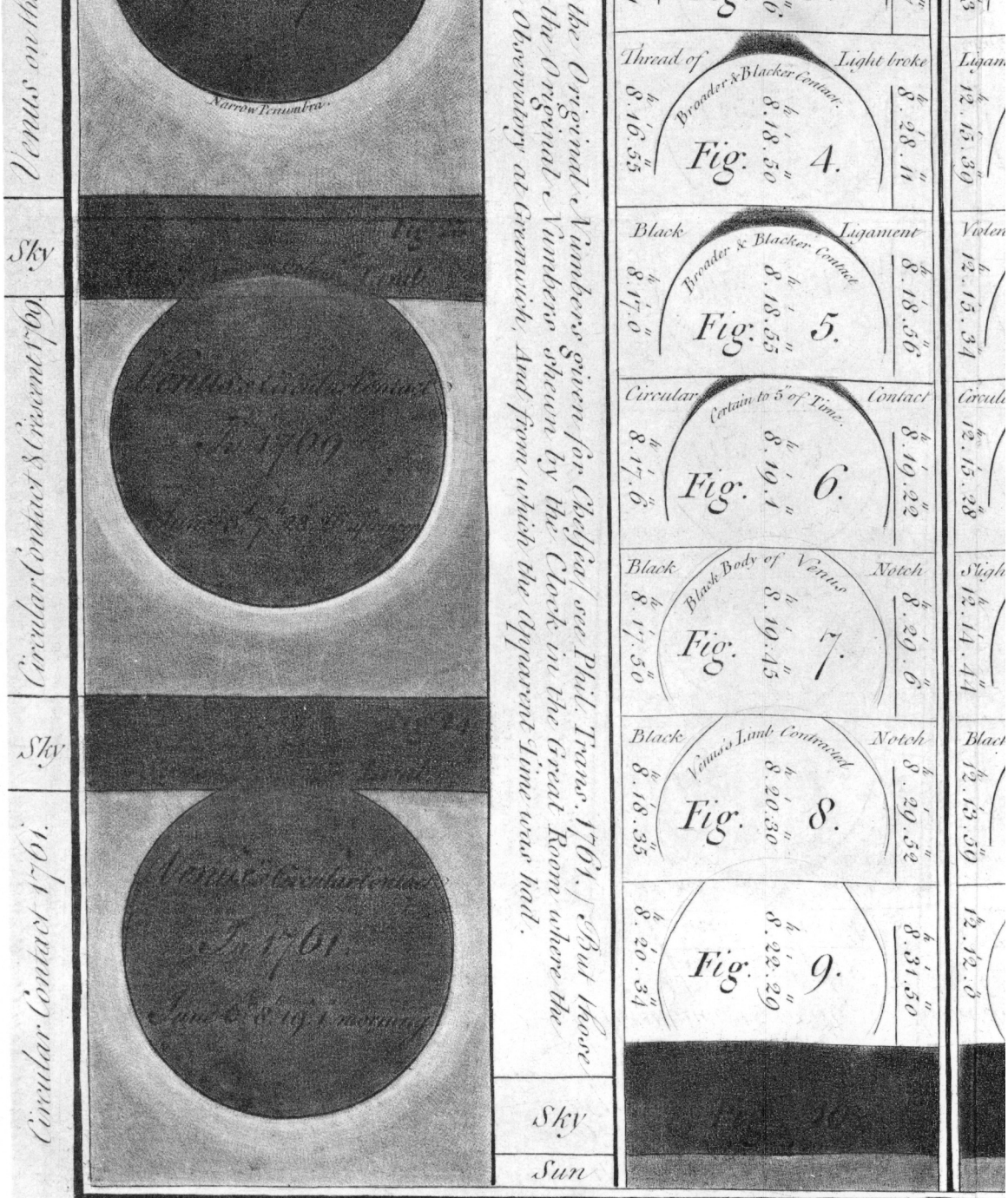


Two Minutes of Time. In 1761. nearly the same time in protuberating. S.Dunn.

Basire sc.

|                |                 |   |   |   |   |
|----------------|-----------------|---|---|---|---|
| <p>Fig. 4.</p> | <p>Fig. 14.</p> | <p>8. 18.38</p> <p>8. 18.50</p> <p>8. 18.44</p> <p>8. 18.46</p> <p>8. 18.44</p> <p>8. 18.42</p> | <p>8. 36.55</p> <p>8. 37.3</p> <p>8. 37.1</p> <p>8. 36.50</p> <p>8. 36.57</p> <p>8. 36.55</p> | <p>7. 10.45</p> <p>7. 10.37</p> <p>7. 10.39</p> <p>7. 10.41</p> <p>7. 10.43</p> <p>7. 10.45</p> | <p>7. 29.</p> <p>7. 29.</p> <p>7. 29.</p> <p>7. 29.</p> <p>7. 29.</p> <p>7. 29.</p> |
| <p>Fig. 5.</p> | <p>Fig. 15.</p> | <p>8. 18.55</p> <p>8. 18.53</p> <p>8. 18.51</p> <p>8. 18.49</p> <p>8. 18.47</p>                 | <p>8. 37.3</p> <p>8. 37.1</p> <p>8. 36.50</p> <p>8. 36.57</p> <p>8. 36.55</p>                 | <p>7. 10.37</p> <p>7. 10.39</p> <p>7. 10.41</p> <p>7. 10.43</p> <p>7. 10.45</p>                 | <p>7. 29.</p> <p>7. 29.</p> <p>7. 29.</p> <p>7. 29.</p> <p>7. 29.</p>               |
| <p>Fig. 6.</p> | <p>Fig. 16.</p> | <p>8. 19.1</p> <p>8. 18.59</p> <p>8. 18.57</p> <p>8. 18.55</p> <p>8. 18.53</p>                  | <p>8. 37.3</p> <p>8. 37.1</p> <p>8. 36.50</p> <p>8. 36.57</p> <p>8. 36.55</p>                 | <p>7. 10.37</p> <p>7. 10.39</p> <p>7. 10.41</p> <p>7. 10.43</p> <p>7. 10.45</p>                 | <p>7. 29.</p> <p>7. 29.</p> <p>7. 29.</p> <p>7. 29.</p> <p>7. 29.</p>               |
| <p>Fig. 7.</p> | <p>Fig. 17.</p> | <p>8. 19.45</p> <p>8. 19.43</p> <p>8. 19.41</p> <p>8. 19.39</p> <p>8. 19.37</p>                 | <p>8. 37.3</p> <p>8. 37.1</p> <p>8. 36.50</p> <p>8. 36.57</p> <p>8. 36.55</p>                 | <p>7. 10.37</p> <p>7. 10.39</p> <p>7. 10.41</p> <p>7. 10.43</p> <p>7. 10.45</p>                 | <p>7. 28.</p> <p>7. 28.</p> <p>7. 28.</p> <p>7. 28.</p> <p>7. 28.</p>               |
| <p>Fig. 8.</p> | <p>Fig. 18.</p> | <p>8. 20.30</p> <p>8. 20.28</p> <p>8. 20.26</p> <p>8. 20.24</p> <p>8. 20.22</p>                 | <p>8. 37.3</p> <p>8. 37.1</p> <p>8. 36.50</p> <p>8. 36.57</p> <p>8. 36.55</p>                 | <p>7. 10.37</p> <p>7. 10.39</p> <p>7. 10.41</p> <p>7. 10.43</p> <p>7. 10.45</p>                 | <p>7. 27.</p> <p>7. 27.</p> <p>7. 27.</p> <p>7. 27.</p> <p>7. 27.</p>               |
| <p>Fig. 9.</p> | <p>Fig. 19.</p> | <p>8. 22.29</p> <p>8. 22.27</p> <p>8. 22.25</p> <p>8. 22.23</p> <p>8. 22.21</p>                 | <p>8. 37.3</p> <p>8. 37.1</p> <p>8. 36.50</p> <p>8. 36.57</p> <p>8. 36.55</p>                 | <p>7. 10.37</p> <p>7. 10.39</p> <p>7. 10.41</p> <p>7. 10.43</p> <p>7. 10.45</p>                 | <p>7. 25.</p> <p>7. 25.</p> <p>7. 25.</p> <p>7. 25.</p> <p>7. 25.</p>               |
|                |                 | <p>Fig. 10.</p>   | <p>8. 37.3</p> <p>8. 37.1</p> <p>8. 36.50</p> <p>8. 36.57</p> <p>8. 36.55</p>                 | <p>Fig. 20.</p>   | <p>7. 10.</p> <p>7. 10.</p> <p>7. 10.</p> <p>7. 10.</p> <p>7. 10.</p>               |

the point of Contact to Completion of the Thread of Light was near two Minutes of Time. In



the Original Numbers given for Checked (see Phil. Trans. 1761.) But those the Original Numbers shown by the Clock in the Great Room where the Observatory at Greenwich, And from which the apparent time was had.

An 1769 from the first additional ferment around the point of Contact to 5<sup>th</sup> C



The SUN Fig. 21.

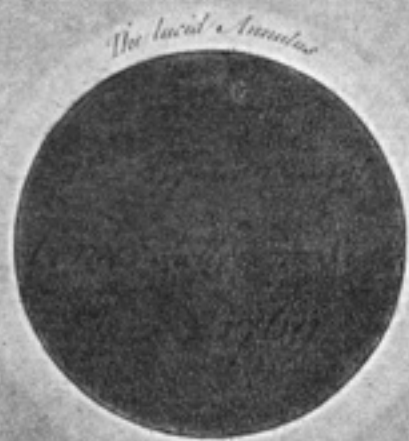


Fig. 21.

Observations of the Transit of VENUS over the Limb of the SUN  
In the Years 1761 & 1769. with the Circumstances & Correspondent Apparent Times  
Referred to the Royal Observatory of GREENWICH, PARIS, &c.

By Samuel Dunn.

| Phenomena in the Year 1761.                 |  | Phenomena in the Year 1769.                 |  | The Time of External & Internal Contact at both Transits by Telescopes of different Powers, referred to Greenwich. |                                |
|---|--|---|--|--|--------------------------------|
| For Block                                   | For Block  | For Block                                   | For Block  | For Block  | For Block                      |
| Black Atoms flowing to the Limb of the Sun. | Black Fibres of Venus retreating from the Limb of the Sun. | Black Atoms flowing to the Limb of the Sun. | Black Fibres of Venus retreating from the Limb of the Sun. | External Contact June 6. 1761.   | Internal Contact June 6. 1761. |
| Fig. 1.                                     | Fig. 11.   | Fig. 1.                                     | Fig. 11.   | 8. 18. 41  | 8. 37. 3                       |
| 8. 18. 39                                   | 8. 37. 1   | 8. 18. 39                                   | 8. 37. 1   | 8. 18. 39  | 8. 37. 1                       |
| 8. 18. 37                                   | 8. 36. 39  | 8. 18. 37                                   | 8. 36. 39  | 8. 18. 37  | 8. 36. 39                      |
| 8. 18. 35                                   | 8. 36. 37  | 8. 18. 35                                   | 8. 36. 37  | 8. 18. 35  | 8. 36. 37                      |
| 8. 18. 33                                   | 8. 36. 35  | 8. 18. 33                                   | 8. 36. 35  | 8. 18. 33  | 8. 36. 35                      |
| 8. 18. 44                                   | 8. 37. 3   | 8. 18. 44                                   | 8. 37. 3   | 8. 18. 44  | 8. 37. 3                       |
| 8. 18. 42                                   | 8. 37. 1   | 8. 18. 42                                   | 8. 37. 1   | 8. 18. 42  | 8. 37. 1                       |
| 8. 18. 40                                   | 8. 36. 39  | 8. 18. 40                                   | 8. 36. 39  | 8. 18. 40  | 8. 36. 39                      |
| 8. 18. 38                                   | 8. 36. 37  | 8. 18. 38                                   | 8. 36. 37  | 8. 18. 38  | 8. 36. 37                      |
| 8. 18. 36                                   | 8. 36. 35  | 8. 18. 36                                   | 8. 36. 35  | 8. 18. 36  | 8. 36. 35                      |
| 8. 18. 46                                   | 8. 37. 3   | 8. 18. 46                                   | 8. 37. 3   | 8. 18. 46  | 8. 37. 3                       |
| 8. 18. 44                                   | 8. 37. 1   | 8. 18. 44                                   | 8. 37. 1   | 8. 18. 44  | 8. 37. 1                       |
| 8. 18. 42                                   | 8. 36. 39  | 8. 18. 42                                   | 8. 36. 39  | 8. 18. 42  | 8. 36. 39                      |
| 8. 18. 40                                   | 8. 36. 37  | 8. 18. 40                                   | 8. 36. 37  | 8. 18. 40  | 8. 36. 37                      |
| 8. 18. 38                                   | 8. 36. 35  | 8. 18. 38                                   | 8. 36. 35  | 8. 18. 38  | 8. 36. 35                      |
| 8. 18. 50                                   | 8. 37. 3   | 8. 18. 50                                   | 8. 37. 3   | 8. 18. 50  | 8. 37. 3                       |
| 8. 18. 48                                   | 8. 37. 1   | 8. 18. 48                                   | 8. 37. 1   | 8. 18. 48  | 8. 37. 1                       |
| 8. 18. 46                                   | 8. 36. 39  | 8. 18. 46                                   | 8. 36. 39  | 8. 18. 46  | 8. 36. 39                      |
| 8. 18. 44                                   | 8. 36. 37  | 8. 18. 44                                   | 8. 36. 37  | 8. 18. 44  | 8. 36. 37                      |
| 8. 18. 42                                   | 8. 36. 35  | 8. 18. 42                                   | 8. 36. 35  | 8. 18. 42  | 8. 36. 35                      |
| 8. 18. 55                                   | 8. 37. 3   | 8. 18. 55                                   | 8. 37. 3   | 8. 18. 55  | 8. 37. 3                       |
| 8. 18. 53                                   | 8. 37. 1   | 8. 18. 53                                   | 8. 37. 1   | 8. 18. 53  | 8. 37. 1                       |
| 8. 18. 51                                   | 8. 36. 39  | 8. 18. 51                                   | 8. 36. 39  | 8. 18. 51  | 8. 36. 39                      |
| 8. 18. 49                                   | 8. 36. 37  | 8. 18. 49                                   | 8. 36. 37  | 8. 18. 49  | 8. 36. 37                      |
| 8. 18. 47                                   | 8. 36. 35  | 8. 18. 47                                   | 8. 36. 35  | 8. 18. 47  | 8. 36. 35                      |
| 8. 19. 1                                    | 8. 37. 3   | 8. 19. 1                                    | 8. 37. 3   | 8. 19. 1   | 8. 37. 3                       |
| 8. 18. 59                                   | 8. 37. 1   | 8. 18. 59                                   | 8. 37. 1   | 8. 18. 59  | 8. 37. 1                       |
| 8. 18. 57                                   | 8. 36. 39  | 8. 18. 57                                   | 8. 36. 39  | 8. 18. 57  | 8. 36. 39                      |
| 8. 18. 55                                   | 8. 36. 37  | 8. 18. 55                                   | 8. 36. 37  | 8. 18. 55  | 8. 36. 37                      |
| 8. 18. 53                                   | 8. 36. 35  | 8. 18. 53                                   | 8. 36. 35  | 8. 18. 53  | 8. 36. 35                      |
| 8. 19. 45                                   | 8. 37. 3   | 8. 19. 45                                   | 8. 37. 3   | 8. 19. 45  | 8. 37. 3                       |
| 8. 19. 43                                   | 8. 37. 1   | 8. 19. 43                                   | 8. 37. 1   | 8. 19. 43  | 8. 37. 1                       |
| 8. 19. 41                                   | 8. 36. 39  | 8. 19. 41                                   | 8. 36. 39  | 8. 19. 41  | 8. 36. 39                      |
| 8. 19. 39                                   | 8. 36. 37  | 8. 19. 39                                   | 8. 36. 37  | 8. 19. 39  | 8. 36. 37                      |
| 8. 19. 37                                   | 8. 36. 35  | 8. 19. 37                                   | 8. 36. 35  | 8. 19. 37  | 8. 36. 35                      |
| 8. 20. 30                                   | 8. 37. 3   | 8. 20. 30                                   | 8. 37. 3   | 8. 20. 30  | 8. 37. 3                       |
| 8. 20. 28                                   | 8. 37. 1   | 8. 20. 28                                   | 8. 37. 1   | 8. 20. 28  | 8. 37. 1                       |
| 8. 20. 26                                   | 8. 36. 39  | 8. 20. 26                                   | 8. 36. 39  | 8. 20. 26  | 8. 36. 39                      |
| 8. 20. 24                                   | 8. 36. 37  | 8. 20. 24                                   | 8. 36. 37  | 8. 20. 24  | 8. 36. 37                      |
| 8. 20. 22                                   | 8. 36. 35  | 8. 20. 22                                   | 8. 36. 35  | 8. 20. 22  | 8. 36. 35                      |
| 8. 22. 29                                   | 8. 37. 3   | 8. 22. 29                                   | 8. 37. 3   | 8. 22. 29  | 8. 37. 3                       |
| 8. 22. 27                                   | 8. 37. 1   | 8. 22. 27                                   | 8. 37. 1   | 8. 22. 27  | 8. 37. 1                       |
| 8. 22. 25                                   | 8. 36. 39  | 8. 22. 25                                   | 8. 36. 39  | 8. 22. 25  | 8. 36. 39                      |
| 8. 22. 23                                   | 8. 36. 37  | 8. 22. 23                                   | 8. 36. 37  | 8. 22. 23  | 8. 36. 37                      |
| 8. 22. 21                                   | 8. 36. 35  | 8. 22. 21                                   | 8. 36. 35  | 8. 22. 21  | 8. 36. 35                      |
| 8. 20. 30                                   | 8. 37. 3   | 8. 20. 30                                   | 8. 37. 3   | 8. 20. 30  | 8. 37. 3                       |
| 8. 20. 28                                   | 8. 37. 1   | 8. 20. 28                                   | 8. 37. 1   | 8. 20. 28  | 8. 37. 1                       |
| 8. 20. 26                                   | 8. 36. 39  | 8. 20. 26                                   | 8. 36. 39  | 8. 20. 26  | 8. 36. 39                      |
| 8. 20. 24                                   | 8. 36. 37  | 8. 20. 24                                   | 8. 36. 37  | 8. 20. 24  | 8. 36. 37                      |
| 8. 20. 22                                   | 8. 36. 35  | 8. 20. 22                                   | 8. 36. 35  | 8. 20. 22  | 8. 36. 35                      |
| 8. 22. 29                                   | 8. 37. 3   | 8. 22. 29                                   | 8. 37. 3   | 8. 22. 29  | 8. 37. 3                       |
| 8. 22. 27                                   | 8. 37. 1   | 8. 22. 27                                   | 8. 37. 1   | 8. 22. 27  | 8. 37. 1                       |
| 8. 22. 25                                   | 8. 36. 39  | 8. 22. 25                                   | 8. 36. 39  | 8. 22. 25  | 8. 36. 39                      |
| 8. 22. 23                                   | 8. 36. 37  | 8. 22. 23                                   | 8. 36. 37  | 8. 22. 23  | 8. 36. 37                      |
| 8. 22. 21                                   | 8. 36. 35  | 8. 22. 21                                   | 8. 36. 35  | 8. 22. 21  | 8. 36. 35                      |
| 8. 20. 30                                   | 8. 37. 3   | 8. 20. 30                                   | 8. 37. 3   | 8. 20. 30  | 8. 37. 3                       |
| 8. 20. 28                                   | 8. 37. 1   | 8. 20. 28                                   | 8. 37. 1   | 8. 20. 28  | 8. 37. 1                       |
| 8. 20. 26                                   | 8. 36. 39  | 8. 20. 26                                   | 8. 36. 39  | 8. 20. 26  | 8. 36. 39                      |
| 8. 20. 24                                   | 8. 36. 37  | 8. 20. 24                                   | 8. 36. 37  | 8. 20. 24  | 8. 36. 37                      |
| 8. 20. 22                                   | 8. 36. 35  | 8. 20. 22                                   | 8. 36. 35  | 8. 20. 22  | 8. 36. 35                      |
| 8. 22. 29                                   | 8. 37. 3   | 8. 22. 29                                   | 8. 37. 3   | 8. 22. 29  | 8. 37. 3                       |
| 8. 22. 27                                   | 8. 37. 1   | 8. 22. 27                                   | 8. 37. 1   | 8. 22. 27  | 8. 37. 1                       |
| 8. 22. 25                                   | 8. 36. 39  | 8. 22. 25                                   | 8. 36. 39  | 8. 22. 25  | 8. 36. 39                      |
| 8. 22. 23                                   | 8. 36. 37  | 8. 22. 23                                   | 8. 36. 37  | 8. 22. 23  | 8. 36. 37                      |
| 8. 22. 21                                   | 8. 36. 35  | 8. 22. 21                                   | 8. 36. 35  | 8. 22. 21  | 8. 36. 35                      |

The Times per Clock for 1761. are the Original Numbers given for the Clock in the great Room where the other Times per Clock for 1769. are the Original Numbers given by the Clock in the great Room where the observation was made in the Royal Observatory at Greenwich. And from which the apparent Time was had.

